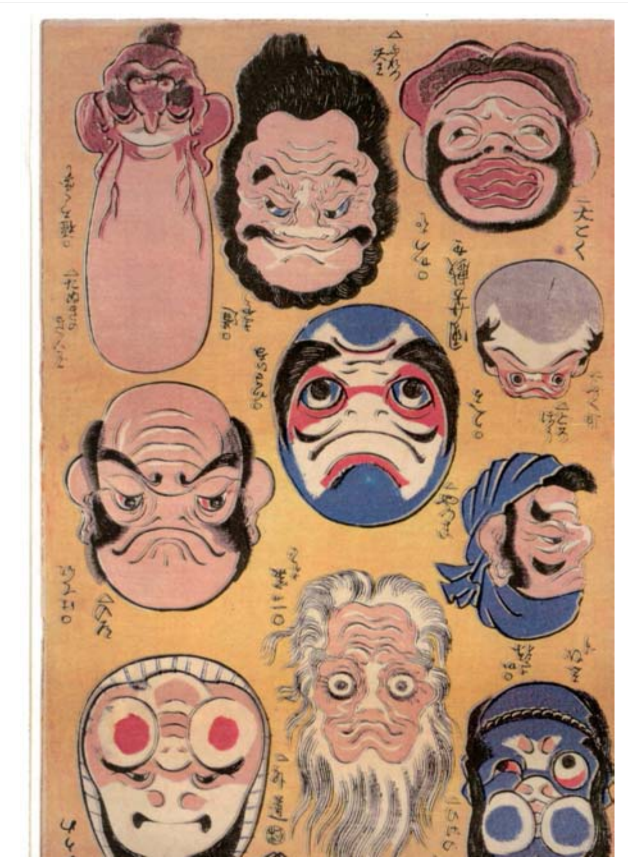
NEWS from ARO-FE (June 2001) : Quantum Dots for Quantum Computing … the human dream in Computer Science ..



An International Workshop (IWQDQC), sponsored by ARO-FE, will take place January 26 to 28, in Kochi, Japan. The Chairman of this workshop is Professor Hideaki Matsueda (**matsueda@is.kochi-u.ac.jp**).

" … Less than a decade ago, quantum computing was just an intellectual parlor game, a way for theorists to test their mettle by imagining absurdly small computers with parts the size of individual atoms…"

Mar 27, 2001 New York Times "Computing, One Atom at a Time"

http://www.nytimes.com/2001/03/27/science/27QUAN.html

The workshop is designed to discover breakthroughs (by way of quantum dots - artificial molecules) for the realization of a practical Quantum Computer. One way to save space (hardware volume) is to hold information by the quantum superposition, like the old Japanese dual face cartoon [Kuniyoshi Kaiki Hyakkei", ed. Toshihiko Isao, Kokkai-kankokai (1999), Fig.109] representing two characters at the same position (space). In the solid state quantum computer, an array of just 40 positions (qubits) as an example, consisting of ensembles of quantum dots could hold millions of millions pieces of information. This results in an extremely compact and yet extremely high capacity computer, because the minimum quantum dot separation could be as small as one nm (one billionth of a millimeter).

Our conventional computer, no matter how much money we pay for it, provides us only the complete freedom in the P region or limited freedom with some error in the BPP region [Figure below]. However, once the quantum superposition principle is introduced, our territory expands over the EQP region and throughout the BQP regions. Then it may be natural to expect that the human dream (to make the "NP Complete" problem - in the hatched region - tractable by inventing a novel computer) would be realized .. although further additional breakthroughs are required!

ON "COMPUTATIONAL COMPLEXITY":

DL and NL – (Non)-Deterministic Logarithmic space: Problems practically solvable any way, by conventional small computers such as a pocket calculator.

P – Polynomial time: Problems practically solvable by conventional personal computers and super computers.

NP – Non-deterministic Polynomial time: Problems practically unsolvable by conventional personal computers, and super computers. Too much time is required (even beyond astronomical figures, ex. 10 to the power of 20 years) for the conventional computers to examine all the candidate solutions one by one. However, it is easy even for the conventional computers to examine the validity of any given provisional solution. In other words, to find out the solution first from nothing is almost impossible. NP Complete (hatched area): The most difficult problems in the NP regime, having been a major human dream in computer science.

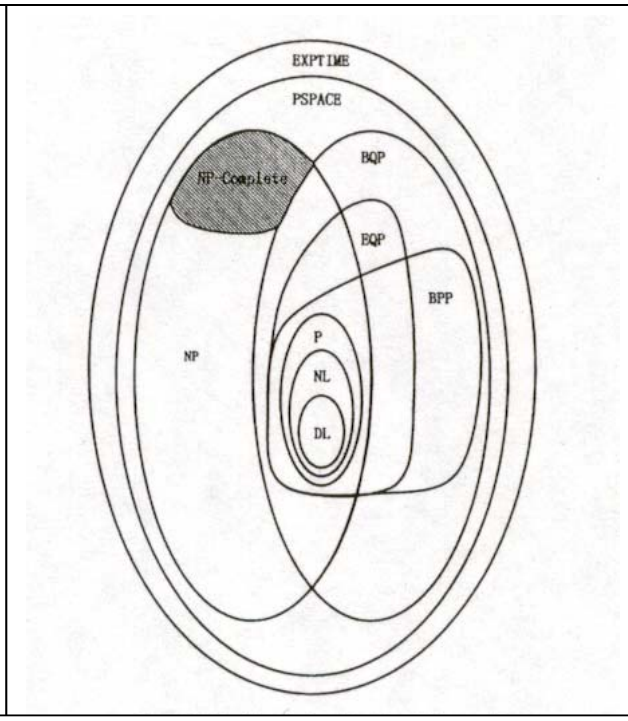
BPP – Bounded Error Probabilistic Polynomial time: Problems practically solvable by the conventional computers only if we allow some (limited) errors and the probabilistic approach.

EQP – Exact Quantum Polynomial time: Problems exactly solvable by a quantum computer in a practical time.

BQP – Bounded error Quantum Polynomial time: Problems practically solvable by a quantum computer only if we allow some (limited) errors.

PSPACE – Polynomial Space (deterministic & non-determin.): Problems that require so large a scale of computing apparatus that shoots out of our hardware resources in this universe

EXPTIME: Problems that require astronomically long (or even beyond astronomical order of) time to compute.



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